Application of Wave Field Synthesis in electronic music and sound installations

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Overview

- Introduction
  - Spatialisation in electronic music
  - Theory of Wave Field Synthesis
- System setup
- Interface Software
- Application in composition & sound installations
- Outlook & discussion
Spatialisation in EM

- Since early development of electronic music an interest in spatial sound
- Standards are quadraphonic or octaphonic setups, with or without ambisonic techniques
- A lot of examples of setups with a lot of loudspeakers for one specific piece or as a way of interpreting a work
- Overview in Malham’s article in Computer Music Journal, winter 1996

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Spatialisation in EM

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**Wave Field Synthesis could be an interesting technique in EM**

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Wave Field Synthesis

- Principle of Huygens
- Principle of Wave Field Synthesis
- Possibilities with Wave Field Synthesis
- Limitations
- Practical applications

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Principle of Huygens

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Principle of Wave Field Synthesis

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Possibilities

- Synthesize sound sources on specific places, even in front of the loudspeakers
- Moving sound sources
- Simulate acoustics of a room, by synthesizing reflections
- No sweet spot, but a large listening area!
Limitations

- Frequency limitations
  - Low frequencies limited by size of speakers
    - \( \rightarrow \) subwoofers!
  - High frequencies limited through spatial aliasing: the further apart the speakers, the lower the high frequency limit
- Computation: for each speaker a signal needs to be calculated
- A lot of speakers are needed!
Limitations

- Frequency limitations are inherent to the theory and characteristics of loudspeakers
- Computation seems to be a matter of time; cpu power increases
- Loudspeaker panels are becoming available, as well as multi-exciter flat panel loudspeakers, partly with built-in computation units for wave field synthesis
Applications

- Direct sound enhancement
- Virtual reality
- Cinema
- Teleconferencing
- Simulation
- Research
- Electronic music

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System of the TU Berlin

- 24 speakers (FOSTEX personal monitor 6301B)
- PC with RME Hammerfall soundcard running Linux
- Interface software:
  * graphical interface
  * calculates the delays and attenuations
  * Controls the convolution engine (BruteFIR) that makes the convolutions in real time and feeds the soundcard with the output sound
  * Is controllable via OpenSoundControl

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Interface software: WONDER

- Created to provide an interface for composers and sound artists of electronic music
- Has to be usable without the user needing to worry about the actual calculations
- Has to be flexible with regard to the actual setup of the system
Interfacesoftware: WONDER

3 parts:
- Composition tool
- Grid definition tool
- Play engine

- Control possible via OpenSoundControl

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WONDER - composition

- For each source:
  * Type
  * Movement
  * Reflections, also variable rooms
  * Division in time sections
  * Possible to loop movements
- Positions and paths can be entered graphically or typed
- WONDER calculates points on the path and a score that can be played.

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WONDER - grid definition

- Allows the user to set a grid of points that can be used for live control of the system.
- Grid can consist of different ‘segments’, of different shapes and spacing and characteristics (high frequency damping, room characteristics).
- Input is graphical or typed.
- WONDER calculates the points and the necessary filters.

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Application of wave field synthesis in electronic music and sound installations
WONDER - grid definition

Application of wave field synthesis in electronic music and sound installations
WONDER - play engine

- The play engine consists of:
  * Convolution engine BruteFIR, which is run as a child process
  * Communication with BruteFIR via the “command line interface” to control the movement of sources (switching between filters)
  * Control over the movements by the user, either graphically via WONDER or by sending OSC messages to WONDER
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WONDER - Open Sound Control

The OpenSoundControl server* of WONDER allows external control over the program

* Over sources: “/WFS/source/” with messages for position, type, etc.
* Over a score: “/WFS/score/” with messages for play, record, pause, stop, save, time
* Over the engine: “/WFS/” with messages for init (initialisation), start, stop

* OSC-server created by Daniel Plewe

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Work with composers

- Done in December 2002/January 2003 in preparation for Club Transmediale Festival in February 2003 in Berlin
- After a general introduction in December, one to two days work with composer in studio for spatialisation
- Sound material was prepared elsewhere by each composer

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Ping Pong Ballet, Marc Lingk

- Sounds were created from ping pong ball sounds
- So: movements based on ping pong ball game
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- all loop movements
- composition moves from familiar ping pong game to dense vivid sound scape

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Restored to Life, Ilka Theurich

- Use of various movements
- Use of plane waves and point sources
- Use of virtual rooms
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Restored to Life, Ilka Theurich
Beurskrach, M. Baalman

- Concept of an object of a fairly large size, modeled as 4 points on the object
- All points have the same source material, but filtered differently
- Cooperation with Julius Stahl, who made visuals

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Beurskrach, M. Baalman

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Scratch

- Responsive sound installation, created in SuperCollider
- Concept: a virtual sonic creature that develops itself, depending on internal and external impulses
- Movement of the sound is controlled with OSC from SuperCollider

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Future

- Extending external control via OSC
- More complex source definition
  * size
  * frequency dependent directional characteristics
- More work with composers
Where can I hear it?

- Sound installation:
  * 13:00-14:00 and 19:00-20:00 each day of the LAD
  * today: 19:00-21:00
  * and on appointment
- Workshop on Saturday, starting at 15:00

“Kleine Studio”, next to the Kubus, First Floor
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More info

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